

**Project Title:** “Laboratory Study of the Attenuation of Arsenic by Iron (Hydr)oxides in Soils/Sediments”

**Investigator:** Robert Ford (USEPA/ORD/NRMRL/GWERD; Ada, OK 74820; 580-436-8872)

**Introduction to the Problem:** The attenuation or stabilization of arsenic in soils and sediments is often controlled by partitioning reactions to mineral oxides. Iron (hydr)oxide minerals play a major role in arsenic cycling in these environments due to scavenging reactions that occur during Fe precipitation from ground and surface waters. Initially precipitated iron (hydr)oxides are rarely the most stable form, and transformation to more crystalline (or stable) products occurs with time. As a consequence of this transformation, coprecipitated arsenic could potentially be immobilized within crystalline Fe (hydr)oxides. The purpose of this study is to provide baseline rate data on the long-term stabilization of arsenic associated with Fe (hydroxides) under controlled laboratory conditions. This data will aid assessment of the attenuation/stabilization potential for arsenic in soils/sediments with a significant iron (hydr)oxide mineral component.

**Background:** There is limited data to assess the influence of aging processes on the stability of the arsenic-iron (hydr)oxide association. Evidence that arsenic may be remobilized from the solid fraction during iron reduction suggests that formation of a sorption complex alone is insufficient to insure stabilization within soils/sediments. However, there is insufficient data to correlate arsenic remobilization potential to Fe (hydr)oxide crystallinity. In the absence of this data, the establishment of criteria for assessing the long-term attenuation potential of soils/sediments is limited. In order to address this need, fundamental laboratory studies are proposed to assess the time-dependent stability of the arsenic-iron (hydr)oxide association, and the solution conditions under which stabilization is promoted.

**Objectives:** To determine the impact of iron oxide mineral transformations on the reversibility of arsenic partitioning.

**Approach:** Laboratory studies will be performed to assess the role of naturally occurring soil/sediment iron (hydr)oxides on the attenuation/stabilization of arsenic. Changes in the reversibility of arsenic partitioning will be assessed as a function of aging time using model experimental systems. The speciation of solid phase arsenic and iron will be characterized using standard wet chemical methods during iron (hydr)oxide transformation from poorly crystalline to stable mineralogic forms. The influence of important environmental parameters such as pH, temperature and arsenic concentration and redox status will be systematically evaluated. Rate parameters for iron (hydr)oxide crystallization and arsenic stabilization will be determined based on experimental aging results. This information will be used to evaluate relative time scales for arsenic stabilization as a function of environmental conditions. This will facilitate preliminary assessment of the potential arsenic attenuation capacity in soils/sediments with a significant iron (hydr)oxide mineralogic component.

**Accomplishments to date (August 2003):** Laboratory studies have been conducted to provide baseline data on changes in arsenic partitioning that accompany transformation of poorly crystalline iron oxides to more crystalline and stable forms. The results of these studies were reported in a peer-reviewed publication:

Robert G. Ford (2002) Rates of Hydrous Ferric Oxide Crystallization and the Influence on Coprecipitated Arsenic. *Environmental Science and Technology*, 36:2459-2463.

**Near future tasks:** Identification of mechanisms controlling arsenic partitioning in contaminated sediments aged under field conditions. These iron oxide-rich sediments have been collected from a field site for laboratory characterization and aging tests. The chemical bonding mechanism of arsenic in synthetic iron oxides and contaminated sediments as a function of iron oxide mineralogy will be assessed using analytical spectroscopy.